

CLAIMS

1. Crystalline (S)-4-(8-amino-3-(1-(but-2-ynoyl)pyrrolidin-2-yl)imidazo[1,5-a]pyrazin-1-yl)-N-(pyridin-2-yl)benzamide maleate, wherein the crystalline maleate is characterized by a reflection X-ray powder diffraction pattern comprising at least five peaks selected from the group consisting of $5.3^{\circ} \pm 0.2^{\circ}2\theta$, $9.8^{\circ} \pm 0.2^{\circ}2\theta$, $10.6^{\circ} \pm 0.2^{\circ}2\theta$, $11.6^{\circ} \pm 0.2^{\circ}2\theta$, $13.5^{\circ} \pm 0.2^{\circ}2\theta$, $13.8^{\circ} \pm 0.2^{\circ}2\theta$, $13.9^{\circ} \pm 0.2^{\circ}2\theta$, $14.3^{\circ} \pm 0.2^{\circ}2\theta$, $15.3^{\circ} \pm 0.2^{\circ}2\theta$, $15.6^{\circ} \pm 0.2^{\circ}2\theta$, $15.8^{\circ} \pm 0.2^{\circ}2\theta$, $15.9^{\circ} \pm 0.2^{\circ}2\theta$, $16.6^{\circ} \pm 0.2^{\circ}2\theta$, $17.4^{\circ} \pm 0.2^{\circ}2\theta$, $17.5^{\circ} \pm 0.2^{\circ}2\theta$, $18.7^{\circ} \pm 0.2^{\circ}2\theta$, $19.3^{\circ} \pm 0.2^{\circ}2\theta$, $19.6^{\circ} \pm 0.2^{\circ}2\theta$, $19.8^{\circ} \pm 0.2^{\circ}2\theta$, $20.0^{\circ} \pm 0.2^{\circ}2\theta$, $20.9^{\circ} \pm 0.2^{\circ}2\theta$, $21.3^{\circ} \pm 0.2^{\circ}2\theta$, $22.1^{\circ} \pm 0.2^{\circ}2\theta$, $22.3^{\circ} \pm 0.2^{\circ}2\theta$, $22.7^{\circ} \pm 0.2^{\circ}2\theta$, $23.2^{\circ} \pm 0.2^{\circ}2\theta$, $23.4^{\circ} \pm 0.2^{\circ}2\theta$, $23.7^{\circ} \pm 0.2^{\circ}2\theta$, $23.9^{\circ} \pm 0.2^{\circ}2\theta$, $24.5^{\circ} \pm 0.2^{\circ}2\theta$, $24.8^{\circ} \pm 0.2^{\circ}2\theta$, $25.2^{\circ} \pm 0.2^{\circ}2\theta$, $25.6^{\circ} \pm 0.2^{\circ}2\theta$, $26.1^{\circ} \pm 0.2^{\circ}2\theta$, $26.4^{\circ} \pm 0.2^{\circ}2\theta$, $26.7^{\circ} \pm 0.2^{\circ}2\theta$, $26.9^{\circ} \pm 0.2^{\circ}2\theta$, $27.1^{\circ} \pm 0.2^{\circ}2\theta$, $27.6^{\circ} \pm 0.2^{\circ}2\theta$, $28.8^{\circ} \pm 0.2^{\circ}2\theta$, $29.5^{\circ} \pm 0.2^{\circ}2\theta$, $30.0^{\circ} \pm 0.2^{\circ}2\theta$, $30.3^{\circ} \pm 0.2^{\circ}2\theta$, $30.9^{\circ} \pm 0.2^{\circ}2\theta$, $31.5^{\circ} \pm 0.2^{\circ}2\theta$, $31.9^{\circ} \pm 0.2^{\circ}2\theta$, $32.5^{\circ} \pm 0.2^{\circ}2\theta$, $34.0^{\circ} \pm 0.2^{\circ}2\theta$, and $35.1^{\circ} \pm 0.2^{\circ}2\theta$.

2. The crystalline maleate of Claim 1, wherein the crystalline maleate is characterized by a reflection X-ray powder diffraction pattern comprising peaks at $5.3^{\circ} \pm 0.2^{\circ}2\theta$, $9.8^{\circ} \pm 0.2^{\circ}2\theta$, $10.6^{\circ} \pm 0.2^{\circ}2\theta$, $11.6^{\circ} \pm 0.2^{\circ}2\theta$, and $19.3^{\circ} \pm 0.2^{\circ}2\theta$.

3. The crystalline maleate of Claim 2, wherein the crystalline maleate is a crystalline hydrate.

4. The crystalline maleate of Claim 3, wherein the crystalline hydrate is approximately equivalent to a monohydrate.

5. The crystalline maleate of Claim 2, wherein the peaks are present when the reflection X-ray powder diffraction is carried out using Cu-K α radiation.

6. The crystalline maleate of Claim 2, wherein the peaks are present when the reflection X-ray powder diffraction is carried out using a Bruker D8 Advance powder X-ray diffractometer equipped with a LynxEye detector and operating in Bragg-Brentano reflection geometry mode, a tube voltage of 40 kV and current of 40 mA, a variable divergence slit with a 3 $^{\circ}$ window, a step size of $0.02^{\circ}2\theta$, sample rotation of 0.5 rps, and a step time of 37 seconds.

7. The crystalline maleate of Claim 2, wherein the crystalline maleate is further characterized by a differential scanning calorimetry thermogram comprising an endothermic peak at about 174 $^{\circ}$ C.

8. The crystalline maleate of Claim 2, wherein the crystalline maleate is further characterized by a dynamic vapor sorption isotherm exhibiting a water content change of about 0.5% between 20% relative humidity and 80% humidity.

9. The crystalline maleate of Claim 2, wherein the crystalline maleate is further characterized by a differential scanning calorimetry thermogram comprising an endothermic peak at about 174° C, and a dynamic vapor sorption isotherm exhibiting a water content change of about 0.5% between 20% relative humidity and 80% humidity.

10. A pharmaceutical composition comprising the crystalline (S)-4-(8-amino-3-(1-(but-2-ynoyl)pyrrolidin-2-yl)imidazo[1,5-a]pyrazin-1-yl)-N-(pyridin-2-yl)benzamide maleate of any of claims 1 to 9; and at least one pharmaceutically-acceptable excipient.

11. The crystalline (S)-4-(8-amino-3-(1-(but-2-ynoyl)pyrrolidin-2-yl)imidazo[1,5-a]pyrazin-1-yl)-N-(pyridin-2-yl)benzamide maleate of any of claims 1 to 9 for use in the treatment of a hyperproliferative disease.

12. Use of the crystalline (S)-4-(8-amino-3-(1-(but-2-ynoyl)pyrrolidin-2-yl)imidazo[1,5-a]pyrazin-1-yl)-N-(pyridin-2-yl)benzamide maleate of any of claims 1 to 9 in the manufacture of a medicament for the treatment of a hyperproliferative disease.

13. The use of Claim 12, wherein the hyperproliferative disease is chronic lymphocytic leukemia.

14. The use of Claim 12, wherein the hyperproliferative disease is small lymphocytic leukemia.

15. The use of Claim 12, wherein the hyperproliferative disease is mantle cell lymphoma.

16. The use of Claim 12, wherein the hyperproliferative disease is Waldenström's macroglobulinemia.